

2.5. Analysis of pediatric PT and CLE outcomes

All researchers performed an initial review of the videotaped recordings and the student documentation. Given the challenges with measurement via telehealth [18, 51] and that the researchers were reviewing videotaped recordings and the student progress notes, the researchers were unable to perform direct objective outcome measures to evaluate the child's progress and therefore established target behaviors. After the initial review of documentation and video recordings, the researchers held several consensus meetings to establish the target behaviors and their operational definitions based on the goals set for each child and the observed focuses of the therapy (Table 2). Target behaviors were developed to assess quantitative outcomes based on the therapeutic focuses for each child. Each recorded session was then analyzed independently by two researchers (CM, MT, CD, or AH) to assess the target behaviors as well as subjective and qualitative outcomes. These researchers did not participate in the CLE. Consensus meetings were held to resolve any discrepancies between reviewers.

Upon completion of the retrospective analyses of the video recordings and documentation of the experience, the researchers sought to examine the participants' perspectives on the feasibility and acceptability of both the PT and CLE. To do this, questionnaires were developed and distributed to the caregivers, CIs, and students who participated in the experience. The questionnaires were adapted from published ones examining the feasibility and acceptability of similar models [52, 53]. Additionally, to assess the perspectives regarding the CLE, questions were developed regarding how the experience addressed relevant items evaluated on the Clinical Performance Instrument (CPI), which is a validated measure utilized to evaluate PT student performance in their full-time CLEs [54]. The questionnaires were piloted to two experts in survey development and their feedback was incorporated prior to distribution. The questionnaires were distributed electronically 18 months after the experience and data were analyzed using Qualtrics Software (Qualtrics XM, Provo, UT).

3. Results

3.1. Outcomes: General observations

Over time, several observations were made in relation to the pediatric PT telehealth experience. At the

beginning of the sessions, caregivers seemed nervous and provided limited assistance outside of what was asked by the students. As the sessions continued, some caregivers reported they had initiated novel activities outside of the scheduled telehealth sessions related to the therapeutic focuses they were working on within the sessions. An example included a caregiver continuing the fine motor activity throughout the week using small crackers and a small container during snack time to encourage carryover and progression of the activity. It was also noted that caregivers asked more questions and provided more input on new therapeutic ideas in order to better assist their child during the therapy sessions in the home as the sessions progressed. Inclusion of siblings in sessions also increased over time. This appeared to increase the engagement of the child in the session and decrease caregiver stress associated with caring for multiple children while participating in the therapy session. Over time, siblings assumed different roles within therapy sessions including performing the interventions, encouraging their sibling to actively participate in therapy, motivating their sibling and helping the caregiver manage the computer or other device used for video communication. This allowed the caregiver to increase focus on the intervention, therapist instruction, and feedback.

Some technological issues were encountered during the sessions which limited carrying out interventions and assessment of results. These issues were experienced with six of the 11 children. The primary issue was a weak or disrupted internet connection, which often occurred when there was a change of location of treatment within the home, moving room to room, or when the session was relocated outside. The most common issues included a freezing or delayed screen, poor quality audio, or a decrease in the video quality. When these issues occurred, observations became obscured and it was difficult to visualize what was occurring at that point in the session for the students and CIs carrying out the interventions, as well as for the researchers' video analyses. Of the six children with technological issues, one child had issues during every session while the others had issues occur in approximately 50% of the sessions. Poor internet connectivity occurred primarily with those families using phones rather than computers and those in more remote areas with limited broadband service availability. It also occurred frequently with those who changed location during the sessions for interventions that required a different room or being outside the home. Addition-

ally, in some cases, the camera angle was not optimal for viewing certain tasks. This occurred with approximately 25% of the tasks analyzed. This was more likely to occur when there was only one parent or caregiver present, due to the difficulty of adjusting the camera angle while implementing the treatment and maintaining the safety of the child. These suboptimal camera angles also occurred more frequently in the higher-functioning children because the camera had to be moved throughout the sessions since the child was more mobile.

3.2. Outcomes: Response to PT

Based on video analyses, all 11 children made qualitative and quantitative improvements in at least one target behavior (Table 2). Quantitative improvements were noted in 62.5% of the target behaviors of the children in the low-functioning group and in 64.3% and 50% of the children in the middle- and high-functioning groups, respectively. Children who made progress in more target behaviors were more likely to have more family members present during the sessions while those who made less improvement were more likely to have only one caregiver participating, substantial distractions within the environment, limited time between sessions, and limited access to resources. For example, the four children who had only one person present during the sessions made progress in five of the 12 (41.7%) target behaviors while the seven children with more than one person present (including siblings) made progress in 14 of the 21 target behaviors (66.7%).

Categorically, improvements were noted most in target behaviors related to static balance, dynamic balance, and stair navigation. All of the children with static balance as a target behavior showed improvement in this area, while 57% of the children with dynamic balance as a target behavior improved. While only 33% of children improved quantitatively in stair navigation, all of the children demonstrated qualitative improvements in stair climbing. Qualitative observations for improved stair navigation included decreased verbal cues needed, increased initiation of a reciprocal pattern, and an increase in the quality of trunk movement. Sixty-seven percent of the target behaviors related to grasp and upper extremity use and 71% of the target behaviors involving developmental and transitional positions showed improvements. Qualitative improvements were seen in transitional positions as noted through observations of progression to compliant surfaces, decreased

level of support required, and use of more challenging equipment to complete tasks.

3.3. Outcomes: Perspectives of experience

Ten of the 12 (83%) CIs, seven of the 12 (58%) caregivers, and 21 of the 54 (38%) students responded to the survey. Seventy-six percent of student respondents were female and the mean (standard deviation [SD]) age was 26.3 (1.4) years. The amount of prior experience with children (in any capacity) in student respondents varied from no experience (5%) to more than five years (29%). CI respondent demographics are presented in Table 3. Seventy percent of CI respondents and 90.5% of student respondents had little to no experience with telehealth prior to this experience. Following this experience, the average level of student interest based on a 100-point scale, ranging from no interest to complete interest, increased in both pediatrics (45.2 to 52.9) and telehealth (40.3 to 64.1).

3.4. Perspectives on the provision of PT

All CIs, students, and caregivers believed that the children and caregivers were able to work towards their PT goals during the experience. All CIs and caregivers, as well as 95% of students, believed the children benefited from the experience. In addition, all CIs believed that the students were able to build a connection with the caregivers, and 95% of students said the same. Seventy-one percent of caregivers believed they were able to build a connection with the students but only 54% of the caregivers believed the students were able to build a connection to the child. Eighty-six percent of caregivers believed they were able to effectively implement the interventions as instructed via telehealth and the remaining 14% were neutral on their ability. Ninety percent of the CIs and 86% of caregivers believed they could understand the clinical reasoning behind the PT interventions delivered via telehealth while the remaining respondents were neutral on their ability to understand the reasoning. All of the caregivers reported that they continued to implement some (80%) or all (20%) of the recommendations provided during the experience with most caregivers reporting that the reason for stopping implementation was shifting of goals and child progress (Fig. 1).

Table 3
Clinical instructor demographics

Age (mean (SD))	44.78 (9.92)
Gender (N (%))	
Female	10 (100%)
Male	0 (0%)
Highest Academic Degree Earned (N (%))	
Bachelor's Degree	2 (20%)
Master's Degree	2 (20%)
Doctorate Degree (DPT, tDPT, PhD)	6 (60%)
Highest Level Physical Therapy Degree Earned (N (%))	
Bachelor's Degree	2 (20%)
Master's Degree	2 (20%)
Doctorate Degree	6 (60%)
ABPTS Board Certified Clinical Specialist (N (%))	
Yes	4 (40%)
No	6 (60%)
Years practicing as a physical therapist (mean (SD))	18.8 (10.43)
Years of pediatric clinical experience (mean (SD))	15.6 (9.30)
Pediatric physical therapy practice settings (N (%))	
Outpatient	8 (28%)
Inpatient	3 (10%)
Early Intervention	5 (17%)
Home care	1 (3%)
School setting	2 (7%)
Other (Aquatics, orthotics casting, telehealth, NICU)	2 (7%)
Academic	8 (28%)
Years of experience as a clinical instructor (mean (SD))	16.1 (9.52)
Prior knowledge and experience with telehealth (N (%))	
No knowledge or experience	2 (20%)
Familiar but little knowledge and no experience	5 (50%)
Extensive knowledge but no actual experience	0 (0%)
Some knowledge and experience	2 (20%)
Extensive knowledge and experience	1 (10%)

SD: standard deviation.

3.5. Perspectives on the CLE

All CIs and all students believed that it was a valuable student CLE. All CIs and 95% of students believed the CIs were able to effectively instruct, provide feedback, and promote student autonomy via telehealth. Ninety percent of CIs and 86% of students also believed that CIs were able to promote student confidence through the learning experience. All CIs and 86% of families felt that the students were able to learn clinical skills through the experience while the remaining 14% of families were neutral (Fig. 1A–C).

For 13 of the 15 relevant CPI domains, 90% or more of CIs believed the students were able to effectively learn. Eighty percent of CIs believed the students were able to effectively learn in the remaining domains (cultural competence and outcomes assessment). For 10 of the 15 relevant CPI domains, 90% or more of the students believed they were able to effectively learn. For the remaining domains, 86%

believed they effectively learned in screening, 81% in examination, evaluation, and outcomes assessment while 71% believed they effectively learned in diagnosis and prognosis (Fig. 2).

3.6. Qualitative perspectives

Students, CIs, and caregivers provided qualitative perspectives comparing the in-person delivery of PT and education to the delivery via telehealth (Appendix). The most commonly reported benefit of telehealth delivery by students and CIs was an increase in family engagement in therapy because of the “forced” nature of family involvement inherent to telehealth.

Students, CIs, and caregivers commented on the improved access to services with the telehealth delivery for both medically complex patients and patients whose access is limited by distance. The telehealth delivery was believed to be more convenient. One

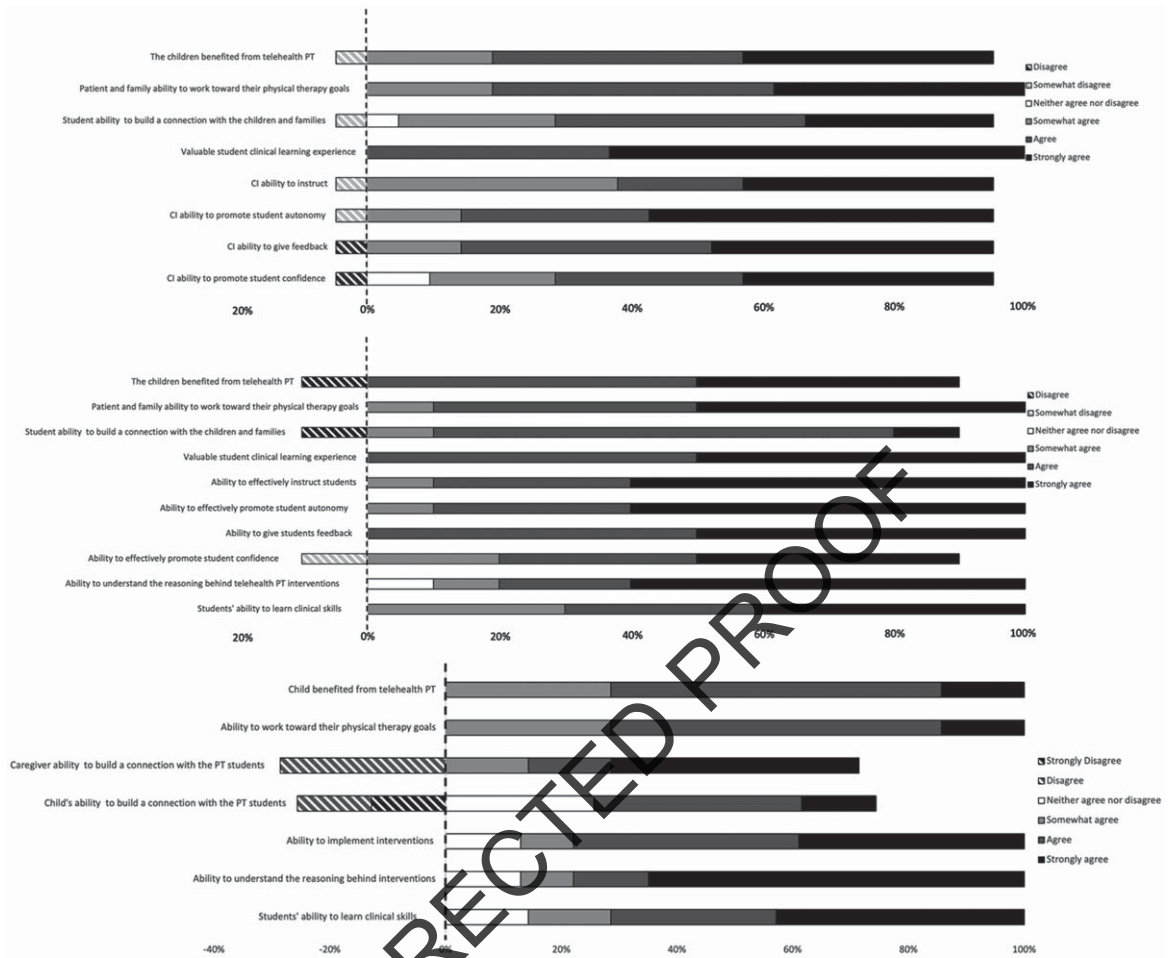


Fig. 1. Perspectives of the students (A), CIs (B), and caregivers (C) on the telehealth PT and learning experience from questionnaires. The percentage of students (A), CIs (B) and caregivers (C) who agreed/ disagreed with statements regarding the ability to benefit from the experience in regards to physical therapy intervention and student learning.

caregiver commented that it was less distracting and overwhelming to the child, particularly with multiple students present. The benefits of treating in the child's natural environment was noted several times by both CIs and students, including the more meaningful nature of treating in the child's home with the child's family and toys.

In the area of student learning, several benefits of telehealth were noted including increased autonomy, learning of communication skills, patient/caregiver education skills, developing creativity, and ability to learn from peers. CIs also noted the benefit of increased discussion with the group for reflection without the family present (i.e., before and after the family joined the session). Finally, it was noted that having experience with telehealth is an important skill for the future.

CIs, students, and caregivers expressed the benefits of in-person therapy over telehealth. Manual contact and assessment were the most common limitations reported for telehealth. The lack of manual contact was thought to limit demonstration, ability to assess accurately, and provision of appropriate sensory cues. Interestingly, one CI noted that the lack of hands-on education might actually improve student skill development in that it forced students to verbalize the knowledge behind the skill. Challenges including visualization, technology, and safety were also noted with telehealth. Inability to visualize appeared to limit the assessment of performance most. Interpersonal connections and the ability to "play" were considered better in-person. This viewpoint was more strongly communicated by caregivers than it was by CIs or students. One perspective that emerged from

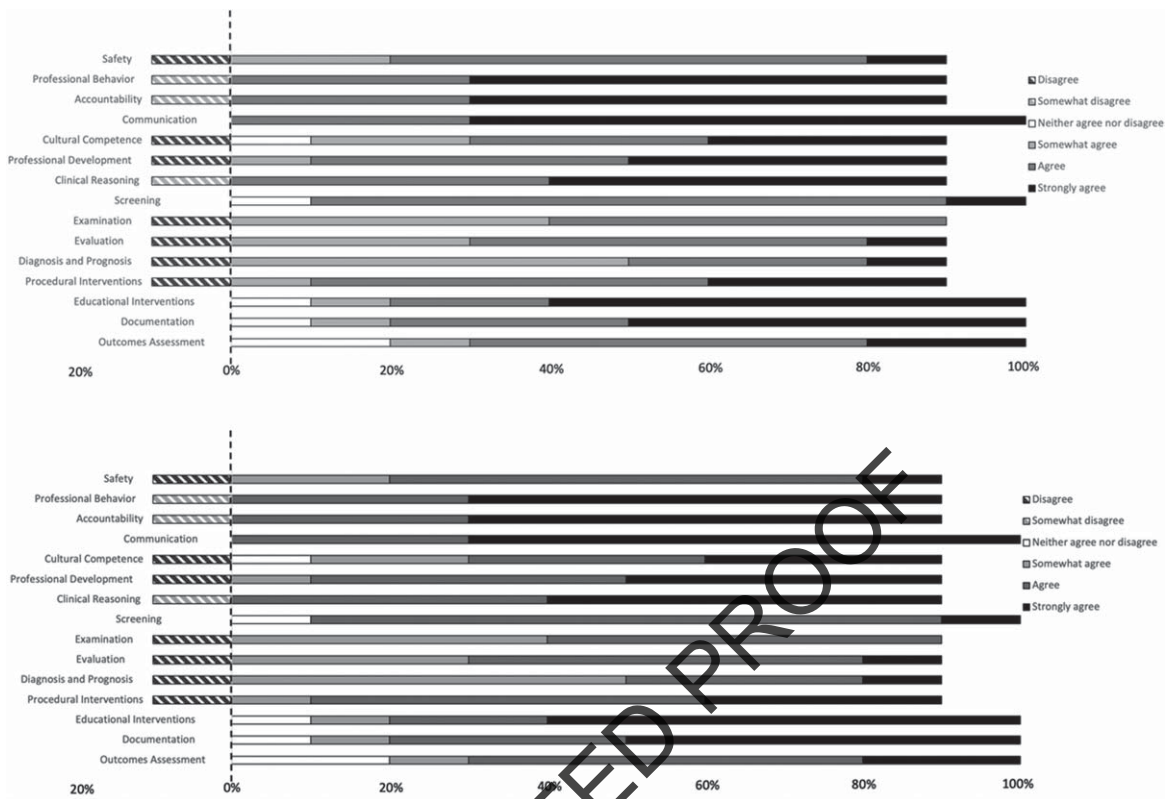


Fig. 2. Perspectives of the students (A) and CIs (B) on the student ability to learn clinical skills in the 15 relevant CPI domains. The percentage of students (A) or CIs (E) who agreed/ disagreed with the statement “I feel that I was able to effectively learn clinical skills in the area of () through telehealth” is depicted. CPI: Clinical Performance Instrument.

the caregivers was the benefit of a hybrid model in which the caregiver could learn in person and practice at home with guidance via telehealth. Caregiver comments suggest that familiarity with PT improves the telehealth experience.

4. Discussion

A retrospective evaluation was conducted of a novel pediatric telehealth collaborative CLE in which children with various levels of support and resources and of various ages and diagnoses participated. Based on empirical and subjective evidence, this model of delivery for pediatric PT appeared to benefit the children and their families. This report describes a model for a clinical experiential learning experience for PT students in both telehealth and pediatric settings that was feasible, easily implemented, and had perceived efficacy and benefits.

The current model illustrated the breadth and depth of pediatric PT that is possible through telehealth.

The interventions implemented via telehealth ranged from developmental positioning and facilitation of fine motor skills, to higher level gait and balance training. Prior studies examining the telehealth delivery of health care services in pediatrics have primarily focused on therapies such as Applied Behavior Analysis (ABA) to target children on the autism spectrum [55, 56]. The limited literature examining the telehealth delivery of pediatric PT has focused predominantly on therapist perspectives of telehealth service delivery [1, 17]. Outside of the single case analysis from which the current report was based [18], the present evaluation is the first report to describe the nature of the interventions performed and the target behaviors of pediatric PT via telehealth. The interventions delivered via telehealth were able to capitalize on the learning opportunities within the children’s natural environment, such as with toy cars, paper towel holders, couch cushions, chalk, playground sets, trampolines, and play sets. While the lack of typical therapeutic equipment was considered a challenge in this telehealth model by both therapists and

students, this forced the students to be more creative with their interventions which is a critical aspect of pediatric PT. Furthermore, this lack of equipment is a challenge faced by families trying to implement PT interventions in the home. Because caregivers in the present model reported using, adapting, and progressing these learning opportunities in between sessions, it is hypothesized that the utilization of resources already in the children's environments enhanced the carryover. Because the treatment occurred in the child's natural environment in which they interact in each day, the therapy itself was more meaningful [23, 47].

While students and instructors perceived examination and assessment as more challenging in this telehealth model, empirical analyses of target behaviors suggested that the children progressed even though the intensity and duration of the experience were limited. Specifically, all of the children progressed in at least one target behavior and progress was noted in a wide variety of target behaviors across all of the children. The biggest challenges reported in the present model related to lack of hands-on assessment and difficulty observing the children due to suboptimal camera angles or poor internet connectivity. This has been widely reported in the telehealth literature [5, 25, 56]. While recommendations have been published on performing assessments via telehealth in the pediatric population [7], there is very limited evidence on the use of motor assessments via telehealth in adults with neurologic conditions [48, 49]. Only one study was identified specifically in the pediatric population [50]. This is clearly an area in need of further investigation.

The present study documented several important observations over time in addition to changes in target behaviors. Across the cases, caregivers reported feelings of stress and anxiety in performing the interventions due to the lack of manual assistance from the therapists. The caregivers' responsibility to maintain camera angles while simultaneously monitoring the child's behavior and attention and performing the interventions appeared to instill a level of stress and anxiety in the caregivers. However, the reports and observations of caregiver anxiety decreased in most of these cases as the sessions progressed and the caregivers' confidence appeared to increase. Therefore, a hybrid model of service delivery in which in-person sessions precede telehealth sessions might help to mitigate the stress associated with implementation. This hybrid model might also serve to enhance the

building of interpersonal connections that were perceived to be more difficult with telehealth.

Sibling involvement in the sessions also increased over time in the present study. For some, the presence of siblings during therapy was initially distracting and stressful for the caregivers but this decreased over time as the siblings became more involved in the therapeutic sessions. The siblings assisted the caregivers with the intervention itself, motivated the child to participate, and even assisted the parent with technological support. Consistent with the literature [57], siblings positively influenced the learning opportunities and rehabilitation of children with disabilities. While the caregivers demonstrated and reported anxiety with the telehealth experience due to the responsibilities inherent in this mode of delivery, the active engagement of the caregivers appeared to increase caregiver involvement in between sessions. Such active engagement has been associated with empowerment and confidence [17, 18] and is consistent with findings reported with the utilization of the coaching method [31, 32]. Enhanced caregiver involvement has been associated with improved motor development in the child and quality of life for both the child and the family [30, 31, 34–36]. Therefore, utilization of the model described in the current study may not only increase the access of PT to families in remote areas, with transportation issues, or medically fragile children, but it may also serve to enhance outcomes associated with PT for children and their families.

The novel collaborative learning experience described in this report provided a model that can be used to address the documented need for the integration of experiential learning into the didactic portion of the curriculum in two critical areas: pediatrics and telehealth [58, 59]. The experiential CLE described appeared to be both feasible and effective based on data triangulated from videotape analyses as well as the perspectives of CIs, students, and caregivers. The majority of CIs, students, and caregivers believed this was an effective CLE. This experience was also believed to promote the confidence and autonomy of students, which was consistent with the qualitative case analysis of this model from which the present study was based [18]. While the CPI was not utilized in the model described, as this model is not considered a clinical education experience, both students and CIs believed that the CLE promoted the development of most of the domains targeted on the CPI, suggesting that this learning model would effectively develop clinical skills. Given the challenges reported

with examination and assessment, it is not surprising that the domains associated with these skills were considered to be least effectively learned through telehealth.

There are several aspects of the current model that may have contributed to the perceived student learning. First, the literature suggests that experiential learning improves the understanding and application of course material including professional skills, interpersonal skills, and clinical skills [60–67]. Second, the collaborative nature of this model, including active observation, peer feedback (via the chat feature), treatment planning, and reflection (via planning meetings and assignments) were consistent with the enhanced learning reported in in-person collaborative experiences [68–70]. In addition to the perception of learning that occurred through this model, student interest in both pediatrics and telehealth increased, suggesting that the experience influenced not only cognitive but also affective domains. Students and CIs had minimal to no experience with telehealth prior to the experience, but after the experience most felt that telehealth should be continued as a venue for service delivery. This speaks to the perceived value of telehealth in clinical practice. Given that touch and personal connection (two areas perceived as limitations in the present model) are foundational aspects of the delivery of PT, it will never be replaced by telehealth. However, the widespread adoption of telehealth due to the COVID-19 pandemic has illuminated the many benefits of this model in the years to come. The perspectives reported in the present evaluation along with those in the literature strongly suggest that clinicians will continue to utilize telehealth as a mode of service delivery, highlighting the importance of developing effective learning experiences in telehealth for future clinicians.

Limitations of the present study must be considered. First, all analyses were completed retrospectively after the model was completed. The questionnaires were not distributed until 18 months after the experience and therefore recall bias must be considered. Second, established objective measures of the outcomes associated were not completed. The literature supports the challenge of assessment via telehealth [18, 51]. While recommendations have been published on performing assessments via telehealth in the pediatric population [7, 47], there is very limited evidence about the use of motor assessments via telehealth in adults with neurologic conditions [48, 49]. Only one study was identified specifically in the pediatric population [50]. Future studies

are needed to examine measurement and assessment through telehealth. Furthermore, the empirical analyses in the present study were conducted on recordings of sessions that were not intended to be systematically analyzed. Inconsistent connectivity and suboptimal camera angles limited the systematic analyses. Because the purpose of developing the model was to provide an experiential learning experience in pediatric PT during the pandemic, objective and validated assessments of both the efficacy of the PT performed and the student learning were not completed. In addition, the model involved only four to five sessions for each child, and therefore, limited progress could be expected. Additionally, while 12 children and their families participated in the model, the videotaped sessions could only be retrieved for 11 of the children. Nevertheless, the wide range of child/family characteristics, the progress that was observed, and the positive perspectives of CIs, students, and caregivers strongly support the continued implementation of this model for both the delivery of service and clinical education. Systematic analyses of child/family and student outcomes associated with this model are warranted. While acceptable response rates for research have certainly been declining [71], the response rate for the student questionnaire (38%) must be considered a limitation. The higher response rates from caregivers and CIs and the consistency of their perspectives with those found for students does, however, support the trustworthiness of the student data and the overall findings.

5. Conclusions

The delivery of pediatric PT via telehealth is feasible and has perceived benefits and efficacy for a wide range of children. This model provides a means of increasing access to pediatric PT that utilizes the natural environment and promotes family engagement. Additionally, this model provides a unique collaborative CLE for students in both pediatric PT and telehealth that appears to be effective across all domains based on the perceptions of CIs, students, and families.

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Ethical considerations

The study was approved by the Shenandoah University Institutional Review Board (#983).

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